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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/051,678	01/16/2002	Li Li	MI22-1795	1161

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EXAMINER

LEBENTRITT, MICHAEL

ART UNIT PAPER NUMBER

2824

DATE MAILED: 05/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/051,678

Applicant(s)

LI ET AL.

Examiner

Michael S. Lebentritt

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-47 is/are pending in the application.
- 4a) Of the above claim(s) 25-35 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-24 and 36-47 is/are rejected.
- 7) ☒ Claim(s) 36 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: ____

DETAILED ACTION

Election/Restrictions

Claims 25-35 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected group II, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 3.

Claim Objections

Claim 36 is objected to because of the following informalities: the limitation "common etching" step appears to refer to conventional prior art techniques; Examiner suggests deleting "common". Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-6, 10, 12, 13, 15-20, 23, 24, 36-43, and 45-47 are rejected under 35 U.S.C. 102(e) as being anticipated by Bjorkman et al, US Patent 6,340,435.

Bjorkman discloses depositing silicon carbide (14) comprising layer at a temperature no greater than 500 C, specifically the substrate surface temperature is

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maintained between 200 to 400 C (See column 13, line 20) and plasma etching through at least apportion of the silicon carbide comprising layer (14) using a gas chemistry comprising oxygen and hydrogen. Bjorkman teaches wherein the hydrogen source is chose from CH_3F , CHF_3 , CH_2F_2 , $\text{C}_2\text{H}_4\text{F}_6$, and C_2HF_5 . (See column 15, line 67 to column 16, line 2) Further: comprising conducting the chemical vapor depositing at a temperature of no great than 200 C, wherein the substrate is not exposed to a temperature of no greater than 500 C between the depositing and the etching. Wherein the substrate is not exposed to a temperature greater than the highest temperature during the depositing between the depositing and the etching. Wherein the CVD is plasma enhanced and wherein the oxygen in derived from the group consisting of O_2 , O_3 , NO_x , CO , CO_2 and mixtures thereof.

In regards to claims 12,13,15-20,23 and 24:

Bjorkman teaches forming an insulative layer (12) over the silicon carbide comprising layer (14); etching a contact opening (26) into the insulative material to proximate the silicon carbide comprising layer; and plasma etching within the contact opening through the silicon carbide comprising layer using a gas chemistry comprising oxygen and hydrogen to extend the contact opening through the silicon carbide comprising layer and under condition which etches the silicon carbide comprising layer at a rate at least twice that of any etching of the insulative material. (See column 5, line 65 to 66) Further forming a conductive material within the contact opening (30). Bjorkman further teaches wherein adjusting the volumetric flow an etch ratio of 3:1 ca be achieved. See column 16, lines 35 to 46).

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In regards to claims 36-43, and 45-47:

Bjorkman further teaches forming a resist (22) over the insulative material (12); forming a mask opening within the resist to proximate the insulative layer (figure 1B); etching a contact hole opening into the insulative material through the mask opening to proximate the silicon carbide comprising layer (figure 1c). See figures 1A-1H and discussion on column 5, line 30 to column 7, line 45 and column 13, lines 12 to 30; column 15, line 60 to column 16, line 50.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7-9,11,14,21,22 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjorkman et al as applied to claims 1-6,10,12,13,15-20,23,24,36-43,and 45-47 above, and further in view of Nguyen et al, US Patent 6,569,257.

Bjorkman is applied supra but lacks the anticipation of wherein hydrogen is derived from the group consisting of H₂, NH₃, CH₄ and mixtures thereof and wherein the plasma etching is conducted within a chamber, plasma during the plasma etching being first formed remote from the camber and wherein the etch selectivity ratio is greater than 4:1. In regards to claim 14, wherein etch selectively is greater than 4:1, Bjorkman teaches that the etch selectivity ratio can be controlled be varying the flow rate of the etchant gases, specifically Bjorkman teaches that an etch selectivity of greater than 3:1

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can be achieved. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to modify the flow rates to achieve a selectivity ratio of 4:1.

In regards to claims 7-9,11,21,22 and 44, Nguyen teaches generating a hydrogen/fluoride-based plasma to remove excess SiC. The hydrogen source and the fluorine source are selected from the group consisting of hydrogen (H_2), methane (CH_4), trifluoromethane (CHF_3), fluoromethane (CH_3F), hydrogen fluoride (HF), carbon tetrafluoride (CF_4); nitrogen trifluoride (NF_3), ammonia (NH_3), sulfur hexafluoride (SF_6), and fluorothane (C_2F_6). Nguyen further teaches that the gas mixture may optionally include an oxygen source. (Please see column 5, lines 44 to 65) Nguyen also teaches that the plasma may be generated remotely. (See column 4, lines 1-7.) In view of this disclosure it would have been obvious to one of ordinary skill in the art at the time of invention to form a hydrogen fluoride based etchant wherein the hydrogen is derived from H_2 , NH_3 , CH_4 and mixtures thereof as taught by Nguyen et al, in view of the primary reference of Bjorkman et al, because the presence of hydrogen decreases the amount of free carbon and CF_2 radicals that result in anisotropic etching.

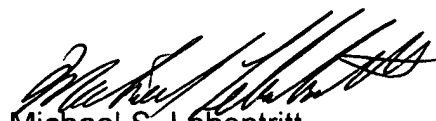
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael S. Lebentritt whose telephone number is 703-305-2691. The examiner can normally be reached on 5/4/9.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on 703-308-2816. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7721 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1732.



Michael S. Lebentritt
Primary Examiner
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May 28, 2003